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(71) Applicant(s):
Samsung Gwangju Electronics Co., Ltd.
(Incorporated in the Republic of Korea)
271 Oseon-dong, Gwangsan-gu,
Gwangju-city, Republic of Korea

(72) Inventor(s):
Jang-keun Oh
Hyoung-jong Jin

(74) Agent and/or Address for Service:
Withers & Rogers
Goldings House, 2 Hays Lane, LONDON,
SE1 2HW, United Kingdom

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WPI Abstract Accession No 1996-110895 &
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(54) Abstract Title: **Rotating overflow grill for cyclone**

(57) A reverse flow cyclone for a vacuum cleaner comprises a tangential inlet 53, a lower removable dust collector 60 and an upper overflow for clean air. The overflow is formed from a cylindrical grill 70 with a solid lower blocking plate 73 for further preventing back-flow of particles. The cylindrical grill wall is formed from a plurality of louvred blades 72 such that the air flow past the blades reverses for the air to pass through them (figures 6 and 7). The grill is mounted on a central spindle 82 aligned approximately with the axis of the cyclone. The spindle is held by a central bearing 81 supported by ribs 81a extending from the upper cover 51b of the cyclone. An additional filter element 90 can be situated downstream of the cyclone.

FIG.3

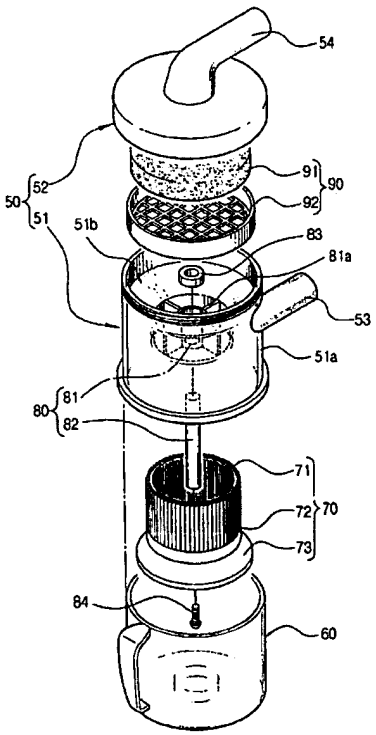

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FIG. 1

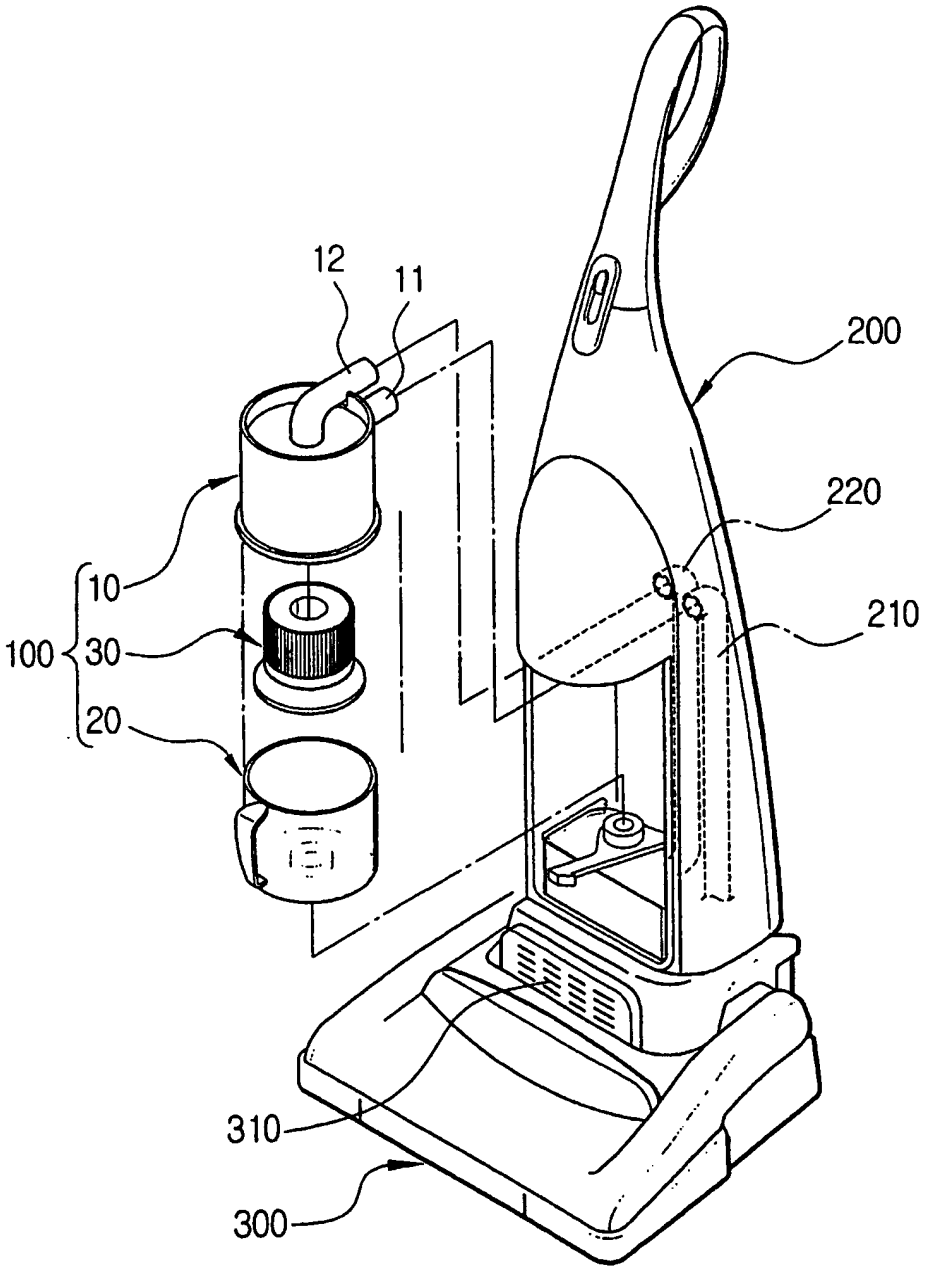


FIG.2

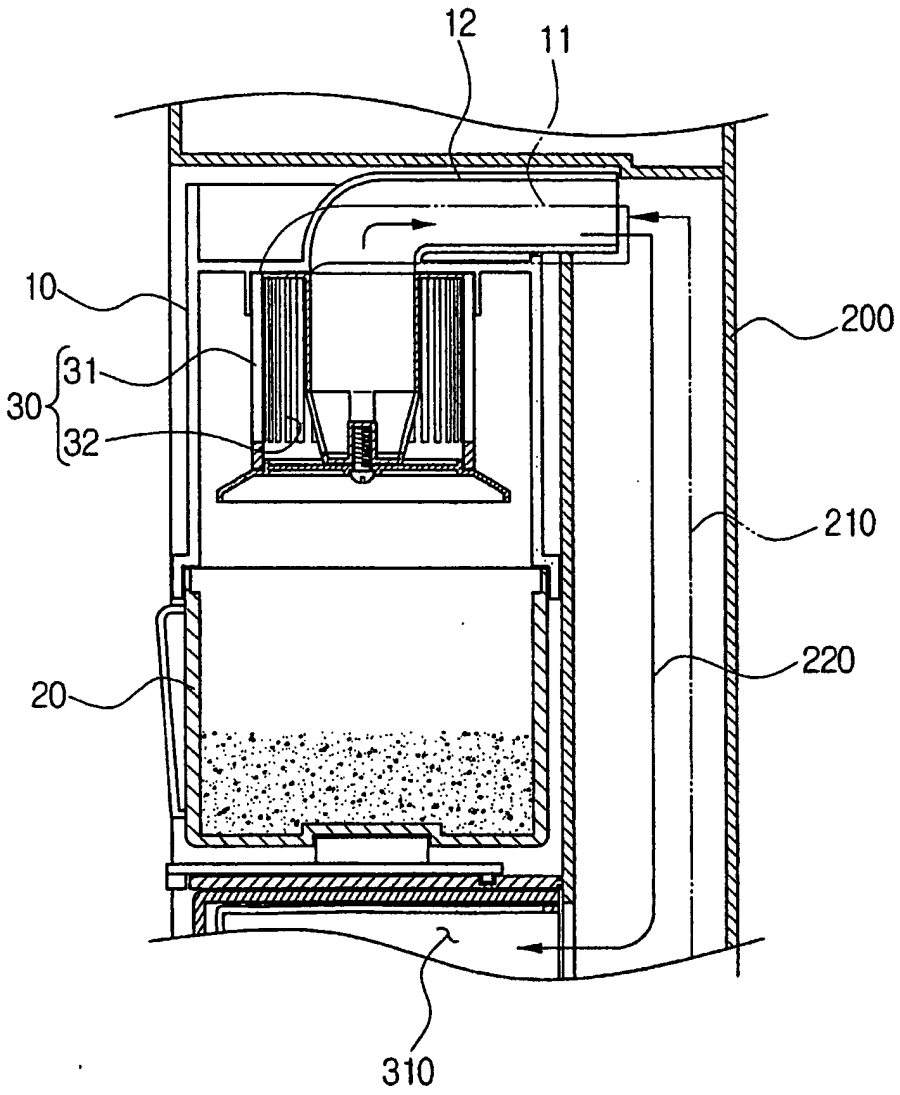


FIG.3

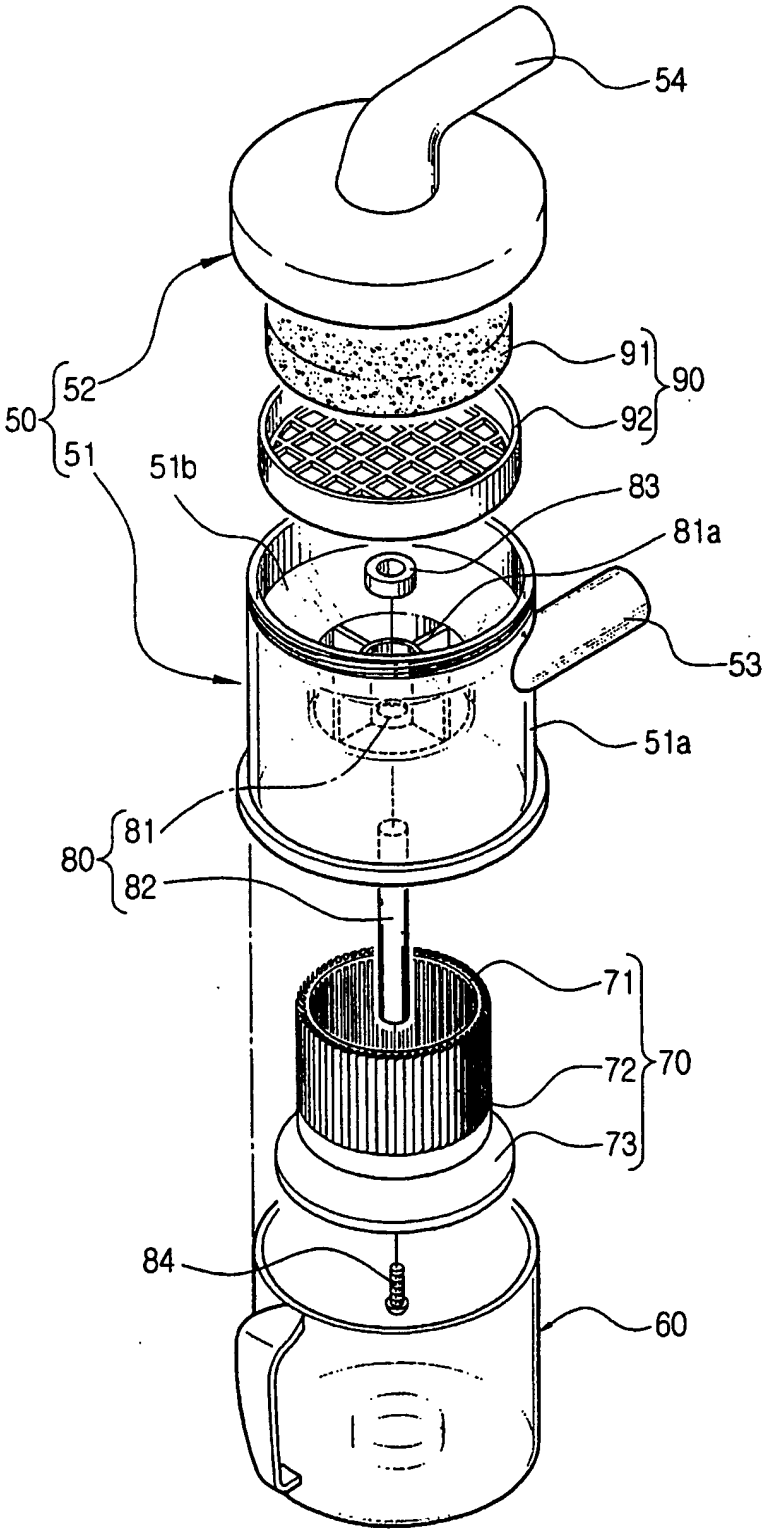


FIG.4

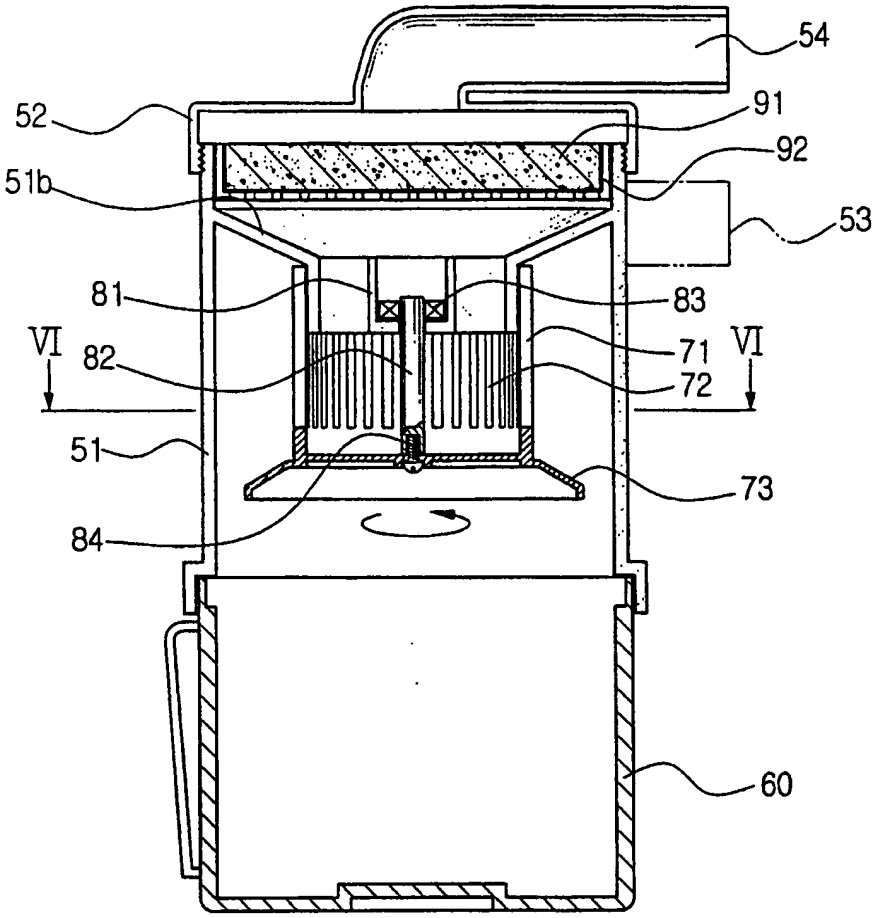


FIG.5

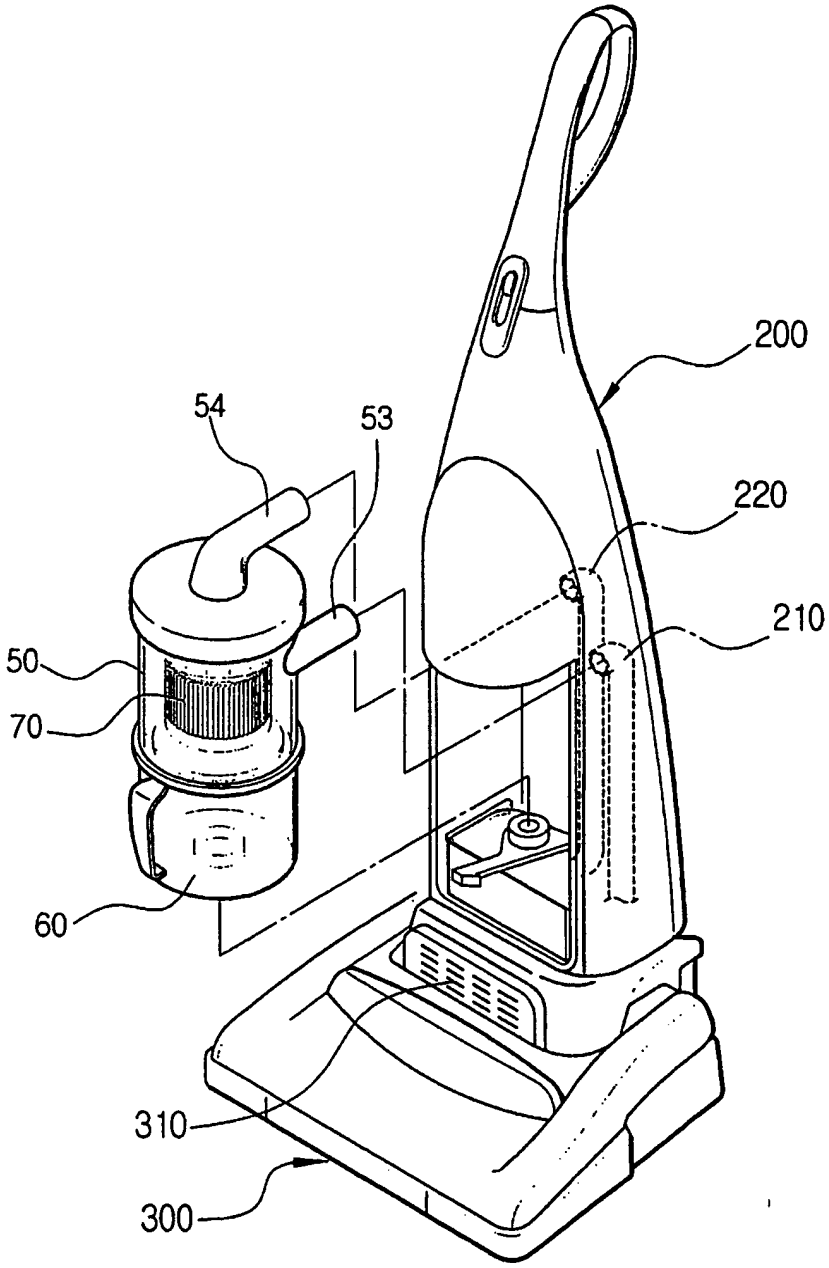


FIG.6

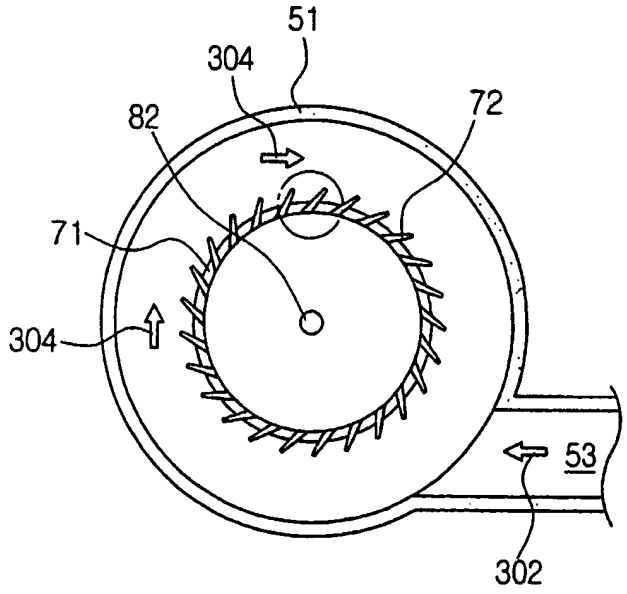
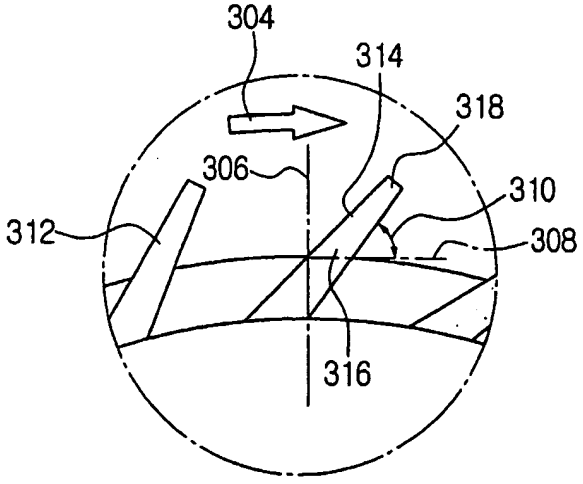


FIG.7



Cyclone Dust-Collecting Apparatus for a Vacuum Cleaner

This invention relates to a vacuum cleaner, and in particular to a cyclone dust-collecting apparatus for a vacuum cleaner for separating and collecting dust and contaminants from contaminant-laden air with a centrifugal force that is formed by generating an air vortex.

A known cyclone dust-collecting apparatus 100 for a vacuum cleaner is shown schematically in Figures 1 and 2. The vacuum cleaner includes a cleaner body 200, and a cleaner brush 300 (not shown in Figure 1). The cyclone dust-collecting apparatus 100 includes a cyclone body 10, a dust receptacle 20 and a grill 30.

As shown in Figures 1 and 2, the cyclone body 10 includes an air inflow pipe 11 and an air outflow pipe 12. The air inflow pipe 11 is connected to an air inflow port (not shown) at one side of the cyclone body 10. The air inflow pipe 11 is connected to an air inflow path 210 configured to be in fluid communication with a suction port (not shown) of the suction brush 300, when the cyclone dust-collecting apparatus is installed in the cleaner body 200. The air outflow pipe 12 is connected to an air outflow port (not shown) at the top of the cyclone body 10. The air outflow pipe 12 is connected to an air outflow path 220 configured to be in fluid communication with a motor chamber 310 of the suction brush 300, when the cyclone dust-collecting apparatus is installed in the cleaner body 200. Contaminant-laden air is drawn in by the suction brush 300 into the cyclone body 10 in a tangential direction, via the air inflow path 210 of the cleaner body 200 and the air inflow pipe 11. The drawn-in air forms a vortex air current in the cyclone body 10, thereby separating dust and contaminants from the contaminant-laden air by the centrifugal force of the vortex air current, whereby clean air is discharged

externally via the air outflow path 220 of the cleaner body 200 and the motor chamber 310.

The dust receptacle 20 is removably connected to the bottom of the cyclone body 10, and receives dust and contaminants separated from the air by the centrifugal force of the vortex air current in the cyclone body 10.

The grill 30 is disposed at an opening of the air outflow pipe 12 inside the cyclone body 10, thereby preventing dust and contaminants separated from the vortex air current from flowing through the air outflow pipe 12. As shown in Figure 2, the grill 30 includes a grill body 31, and a plurality of air paths 32 disposed at an outer circumference of the grill body, the air paths allowing air to flow to the air outflow pipe 12.

The cyclone dust-collecting apparatus described above is installed in the cleaner body 200 such that the air inflow pipe 11 and the air outflow pipe 12 of the cyclone body 10 are respectively connected to the air inflow path 210 and the air outflow path 220 of the cleaner body.

In operation, a suction force is generated at the suction brush 300, which is driven by a motor (not shown) in the motor chamber 310. The generated suction force draws the contaminant-laden air from a surface to be cleaned into the cyclone body 10 through the suction brush 300, the air inflow path 210 and the air inflow pipe 11. The drawn-in air is led through the air inflow pipe 11 along an inner circumference of the cyclone body 10 in an oblique direction to form a vortex air current. Dust and contaminants in the air are separated by the centrifugal force generated by the vortex air current, and are collected in the dust receptacle 20. Clean air is discharged externally through the air paths 32, the air outflow pipe 12, the air outflow path 220 and the motor chamber 310.

However, this cyclone dust-collecting apparatus has the disadvantage of a degradation of the cleaning efficiency, a failure to retain a satisfactory amount of dust, and of allowing dust and contaminants to be discharged with the outflow of the air through the air paths 32 in the grill 30.

An aim of the invention is to provide a cyclone dust-collecting apparatus having an increased cleaning efficiency, by maximising the separation of clean air from contaminated air.

The present invention provides a cyclone dust-collecting apparatus for a vacuum cleaner, the apparatus comprising:

a cyclone body having an air inflow port and an air outflow port, the cyclone body being adapted to form a vortex air current of contaminant-laden air drawn in through the air inflow port;

a dust receptacle removably connected to the cyclone body, the dust receptacle being configured to receive dust and contaminants separated from the air by the centrifugal force of the vortex air current in the cyclone body;

a grill disposed about the air outflow port inside the cyclone body, for preventing flow of dust and contaminants separated from the air through the air outflow port; and

a grill rotation support for supporting the grill for rotation by the vortex air current in the cyclone body.

In a preferred embodiment, the cyclone body comprises:

a cylindrical main body having a side surface in which the air inflow port is formed, and an upper surface in which the air outflow port is formed;

a cover removably connected to the upper surface of the cylindrical main body;

an air inflow pipe configured to connect to an air inflow path of a cleaner main body; and

an air outflow pipe configured to connect to an air outflow path of the cleaner body, the air outflow pipe being disposed about the centre of the cover.

The cylindrical main body and cover may be removably connected to each other by means of spiral connecting mechanisms respectively formed on corresponding surfaces thereof.

Preferably, the grill comprises:

a grill body; and

a plurality of air path members disposed at an outer circumference of the grill body, each air path member being at a predetermined slope angle to form an air passage to the air outflow port. Advantageously, the grill further comprises a contaminant-blocking member disposed at a lower portion of the grill body.

The grill rotation support means may comprises a support member supported at the centre of the air outflow port of the cylindrical main body by a plurality of ribs protruding from an inner surface of the air outflow port; and a rotatable member having a first end rotatably supported by a bearing, and a second end extending through the grill and secured to a lower portion of the grill.

Preferably, the apparatus further comprises fine dust filter assembly positioned between the upper surface of the cylindrical main body and the cover.

The fine dust filter assembly may comprise a fine dust filter, and a filter frame having a lower grid structure, for receiving and supporting the fine dust filter.

Preferably, the upper surface of the cylindrical main body slopes downwardly from a radially outer periphery towards a central portion.

The invention will now be described in greater detail, by way of example, with reference to the drawings, in which:

Figure 1 is an exploded perspective view showing a conventional cyclone dust-collecting apparatus and an associated vacuum cleaner;

Figure 2 is a cross-sectional view of the cyclone dust-collecting apparatus of Figure 1 after assembly and installation;

Figure 3 is an exploded perspective view of a cyclone dust-collecting apparatus constructed in accordance with the invention;

Figure 4 is a cross-sectional view of the assembled cyclone dust-collecting apparatus of Figure 3;

Figure 5 is an exploded perspective view of the cyclone dust-collecting apparatus of Figure 3 prior to installation in a cleaner;

Figure 6 is a cross-section taken on the line VI-VI of Figure 4; and

Figure 7 is an enlarged view of an air path member of the cyclone dust-collecting apparatus of Figure 3.

Referring to the drawings, Figures 3 and 4 show a cyclone dust-collecting apparatus for a vacuum cleaner, the apparatus having a cyclone body 50, a dust receptacle 60, a grill 70 and a grill rotation support 80.

The cyclone body 50 includes a cylindrical main body 51, and a cover 52 removably connected to the cylindrical main body by means of spiral connecting mechanisms (not shown) formed on respective surfaces thereof. The cylindrical main body 51 includes a side surface 51a and an upper surface 51b. An air inflow port is formed at one side of

the side surface 51a, and an air outflow port is formed at the centre of the upper surface 51b. An air inflow pipe 53 is connected to the air inflow port, which is also connected to an air inflow path 210 (see Figure 5) of a cleaner main body 200. An air outflow pipe 54 is connected to the air outflow port at the centre of the cover 52, which is also connected to an air outflow path 220 (see Figure 5) of the cleaner main body 200.

In operation, contaminant-laden air is drawn by a suction brush 300 (see Figure 5) into the cyclone body 50 in a tangential direction, via the air inflow path 210 and the air inflow pipe 53. In this process, a vortex air current is formed in the cyclone body 50, and the dust and contaminants included in the vortex air current are separated from the air by the centrifugal force of the vortex air current. Thus, clean air is discharged externally through the air outflow pipe 54, the air outflow path 220 and a motor chamber 310 (see Figure 5).

The dust receptacle 60 is removably connected to the bottom of the cyclone body 50, and receives the dust and contaminants separated from the air by the vortex air current in the cyclone body 50. The dust receptacle 60 includes a handle for enabling easy handling. When the dust receptacle 60 is full, it can be separated from the cyclone body 50 for emptying.

The grill 70 is disposed at the air outflow port in the cyclone body 50 to assist in separating dust and contaminants separated from the vortex air current thereby preventing them flowing through the air outflow port. The grill 70 includes a grill body 71, and a plurality of air path members 72 disposed in the outer circumference of the grill body, the air path members forming air passages to the air outflow port. The air path members 72 are each disposed at a predetermined slope angle, thereby defining air passages to the air outflow port and to a contaminant-blocking member 73 disposed at a lower portion of the grill body 71.

The grill rotation support 80 includes a support member 81 and a rotatable member 82. The support member 81 is disposed at the centre of the air outflow port of the cylindrical main body 51, and is supported by a plurality of ribs 81a protruding from the inner surface of the air outflow port. The rotatable member 82 has one end rotatably supported by a bearing (not shown). The other end extends through the grill 70, and is fixed thereto at a lower portion thereof by a screw 84. In use, the grill 70 is rotated with the rotatable member 82, with respect to the support member 81, by the vortex air current formed in the cyclone body 50. The rotation of the grill 70 helps to prevent the flow of the dust and contaminants through the air passages 72 of the grill 70.

Figures 6 and 7 show, in detail, the preferred slope angle of the air path members 72 and its relationship to the vortex air current. Contaminant-laden air 302 is drawn in via the air inflow pipe 53 in a tangential direction. As discussed above, this causes the formation of a vortex air current 304 within the cylindrical main body 51, the vortex air current being in a clockwise direction as shown in Figure 6.

The air path members 72 are disposed on the grill body 71 so as to minimise the chance that dust or other contaminants will enter through the grill 70. Figure 7 shows an enlarged view of two adjacent air path members 312 and 314. The air path member 314 has a leading edge 316 and a trailing edge 318. The leading edge 316 is the first edge of the air path member 314 to encounter the vortex air current 304. In other words, the leading edge 316 is upstream of the trailing edge 318. The leading edge 316 is attached to the grill body 71 and the trailing edge 318 is disposed both radially outward of, and circumferentially downstream of, the leading edge 316.

With this arrangement, a slope angle 310 is formed, the slope angle being the angle between a local tangential line 308 and the air path member 314. The local tangential

line 308 is a line perpendicular to a radial line 306 extending from the geometric centre of the grill 70 to the air path member 314. Any air path member that has a slope angle is said to be sloped. The slope angle 310 can be adjusted to suit various design aims. For example, if the slope angle 310 were reduced, that would increase the ability of the grill 70 to separate contaminants from the air, but would also increase the power required to draw air though grill. If the slope angle 310 were increased, that would decrease the separation efficiency of the grill 70, but less power would be required to draw air through grill. Given these various factors, an appropriate slope angle can be selected that best suits particular design aims.

The grill rotation feature and the sloped air path feature can be used separately, or in combination with one another.

As best seen in Figure 4, the contaminant-blocking member 73 is frustoconical with an enlarged lower part whose diameter increases downwardly. This shape may cause any contaminants collected in the dust receptacle 60 that float upwardly to be re-directed by the contaminant-blocking member 73, thereby to fall into the dust receptacle.

The cyclone dust-collecting described above is further provided with a fine dust filter assembly 90 interposed between the cylindrical main body 51 and the cover 52 of the cyclone body 50, thereby to filter fine dust not removed by the grill 70.

The fine dust filter assembly 90 includes a fine dust filter 91, such as a sponge or other porous material, and a filter frame 92 having a lower grid structure for receiving and supporting the fine dust filter. The fine dust filter assembly 90 filters the fine dust which passes through the grill 70, and prevents this fine dust from escaping from the cylindrical main body 51. The upper surface 51b of the body 51 is preferably formed to slope downwardly from its radially outer periphery towards a central portion, so that the

fine dust filtered by the fine dust filter assembly 90 falls down into the dust receptacle 60, instead of remaining between that upper surface 51b and the fine dust filter assembly.

The cyclone dust-collecting apparatus described above can be installed in the cleaner body 200 of the vacuum cleaner, as shown in Figure 5, so that the air inflow pipe 53 and the air outflow pipe 54 of the cyclone body 50 are respectively connected to the air inflow path 210 and the air outflow path 220 of the cleaner body.

In operation, a suction force is generated at the suction brush 300, which is driven by a motor (not shown) in the motor chamber 310. The generated suction force draws contaminant-laden air from a surface to be cleaned into the cyclone body 50 via the suction brush 300, the air inflow path 210 and the air inflow pipe 53. The drawn-in air is led via the air inflow pipe 53 along an inner circumference of the cyclone body 50 in an oblique direction. This helps to form a vortex air current, and the dust and contaminants in the air are separated by the centrifugal force generated by the vortex and collected in the dust receptacle 60. Thereafter, clean air is discharged externally through the air passages of the grill 70, the air outflow pipe 54, the air outflow path 220 and the motor chamber 310. Given this arrangement, dust and contaminants rarely escape through the air passages of the grill 70. However, even if fine dust, which is not separated by the grill 70, is discharged through the air passages of the grill, the fine dust is filtered by the fine dust filter assembly 90 (see Figure 4), thereby improving the amount of dust collected.

As described above, dust and contaminants are separated from the air by centrifugal force, while the grill 70 rotates to prevent the flow of the dust and contaminants through the grill. Consequently, very little, if any dust and contaminants flow through the air passages of the grill 70.

Moreover, even if fine dust flows through the air passages of the grill 70, such fine dust is filtered by the fine dust filter assembly 90, thereby improving the quality of dust collection and also improving the cleaning efficiency.

Claims

1. A cyclone dust-collecting apparatus for a vacuum cleaner, the apparatus comprising:

a cyclone body having an air inflow port and an air outflow port, the cyclone body being adapted to form a vortex air current of contaminant-laden air drawn in through the air inflow port;

a dust receptacle removably connected to the cyclone body, the dust receptacle being configured to receive dust and contaminants separated from the air by the centrifugal force of the vortex air current in the cyclone body;

a grill disposed about the air outflow port inside the cyclone body, for preventing flow of dust and contaminants separated from the air through the air outflow port; and

a grill rotation support for supporting the grill for rotation by the vortex air current in the cyclone body.

2. Apparatus as claimed in claim 1, wherein the cyclone body comprises:

a cylindrical main body having a side surface in which the air inflow port is formed, and an upper surface in which the air outflow port is formed;

a cover removably connected to the upper surface of the cylindrical main body;

an air inflow pipe configured to connect to an air inflow path of a cleaner main body; and

an air outflow pipe configured to connect to an air outflow path of the cleaner body, the air outflow pipe being disposed about the centre of the cover.

3. Apparatus as claimed in claim 2, wherein the cylindrical main body and the cover are removably connected to each other by means of spiral connecting mechanisms respectively formed on corresponding surfaces thereof.

4. Apparatus as claimed in claim 2 or claim 3, wherein the grill comprises:

a grill body; and

a plurality of air path members disposed at an outer circumference of the grill body, each air path member being at a predetermined slope angle to form an air passage to the air outflow port.

5. Apparatus as claimed in claim 4, wherein the grill further comprises a contaminant-blocking member disposed at a lower portion of the grill body.

6. Apparatus as claimed in any one of claims 2 to 5, wherein the grill rotation support comprises:

a support member supported at the centre of the air outflow port of the cylindrical main body by a plurality of ribs protruding from an inner surface of the air outflow port; and

a rotatable member having a first end rotatably supported by a bearing, and a second end extending through the grill and secured to a lower portion of the grill.

7. Apparatus as claimed in any one of claims 2 to 6, further comprising a fine dust filter assembly positioned between the upper surface of the cylindrical main body and the cover.

8. Apparatus as claimed in claim 7, wherein the fine dust filter assembly comprises:

a fine dust filter; and

a filter frame having a lower grid structure, for receiving and supporting the fine dust filter.

9. Apparatus as claimed in claim 7 or claim 8, wherein the upper surface of the cylindrical main body slopes downwardly from a radially outer periphery towards a central portion.

10. A cyclone dust-collecting apparatus for use with a vacuum cleaner comprising, the apparatus comprising:

a cyclone body having an air inflow port and an air outflow port, the cyclone body being adapted to form a vortex air current of contaminant-laden air drawn in through the air inflow port;

a dust receptacle removably connected to the cyclone body, the dust receptacle being configured to receive dust and contaminants separated from the air; and

a grill disposed proximate the air outflow port and inside the cyclone body;

wherein the grill includes at least one air path member, and the air path member is sloped.

11. Apparatus as claimed in claim 10, wherein a leading edge of the air path member is disposed radially inwardly of a trailing edge of the air path member.

12. Apparatus as claimed in claim 10 or claim 11, wherein the grill is rotatably mounted inside the cyclone body.

13. Apparatus as claimed in claim 12, wherein the arrangement is such that the vortex air current rotates the grill in the same direction as the rotational direction of the vortex air current.

14. Apparatus as claimed in claim 12 or claim 13, further comprising a rotatable member having a first end supported by a bearing and a second end rigidly associated with the grill.

15. Apparatus as claimed in claim 14, wherein the bearing is also associated with a support that is attached to the cyclone body.

16. A cyclone dust-collecting apparatus adapted for a vacuum cleaner, the apparatus comprising:

means for forming a vortex air current of contaminant-laden air;

means for receiving dust and contaminants separated from the air by the centrifugal force of the vortex air current; and

means for rotating a grill disposed within a cyclone body.

17. Apparatus as claimed in claim 16, further comprising means for rotatably supporting the grill.

18. Apparatus as claimed in claim 16 or claim 17, further comprising means for filtering fine dust.

19. Apparatus according as claimed in any one of claims 16 to 18, further comprising means for dropping fine dust into a dust receptacle.

20. Apparatus as claimed in any one of claims 16 to 19, further comprising means for minimising flow past the rotatable grill.

Amendments to the claims have been filed as follows

1. A cyclone dust-collecting apparatus for a vacuum cleaner, the apparatus comprising:

a cyclone body having an air inflow port and an air outflow port, the cyclone body being adapted to form a vortex air current of contaminant-laden air drawn in through the air inflow port;

a dust receptacle removably connected to the cyclone body, the dust receptacle being configured to receive dust and contaminants separated from the air by the centrifugal force of the vortex air current in the cyclone body;

a grille disposed about the air outflow port inside the cyclone body, for preventing flow of dust and contaminants separated from the air through the air outflow port;

a grille rotation support for supporting the grille for rotation by the vortex air current in the cyclone body; and

a rotatable member fixed to the grille for rotation relative to the grille rotation support, the grille being so constructed that the vortex air current in the cyclone body directly rotates the grille and the rotatable member relative to the grille rotation support.

2. Apparatus as claimed in claim 1, wherein the cyclone body comprises:

a cylindrical main body having a side surface in which the air inflow port is formed, and an upper surface in which the air outflow port is formed;

a cover removably connected to the upper surface of the cylindrical main body;

an air inflow pipe configured to connect to an air inflow path of a cleaner main body; and

an air outflow pipe configured to connect to an air outflow path of the cleaner body, the air outflow pipe being disposed about the centre of the cover.

3. Apparatus as claimed in claim 2, wherein the cylindrical main body and the cover are removably connected to each other by means of spiral connecting mechanisms respectively formed on corresponding surfaces thereof.

4. Apparatus as claimed in claim 2 or claim 3, wherein the grille comprises:

a grille body; and

a plurality of air path members disposed at an outer circumference of the grille body, each air path member being at a predetermined slope angle to form an air passage to the air outflow port.

5. Apparatus as claimed in claim 4, wherein the grille further comprises a contaminant-blocking member disposed at a lower portion of the grille body.

6. Apparatus as claimed in any one of claims 2 to 5, wherein the grille rotation support comprises:

a support member supported at the centre of the air outflow port of the cylindrical main body by a plurality of ribs protruding from an inner surface of the air outflow port; and

a rotatable member having a first end rotatably supported by a bearing, and a second end extending through the grille and secured to a lower portion of the grille.

7. Apparatus as claimed in any one of claims 2 to 6, further comprising a fine dust filter assembly positioned between the upper surface of the cylindrical main body and the cover.

8. Apparatus as claimed in claim 7, wherein the fine dust filter assembly comprises:

a fine dust filter; and

a filter frame having a lower grid structure, for receiving and supporting the fine dust filter.

9. Apparatus as claimed in claim 7 or claim 8, wherein the upper surface of the cylindrical main body slopes downwardly from a radially outer periphery towards a central portion.